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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/538,306	06/09/2005	Makoto Ueki	Q88465	3461
23373	7590	10/20/2006	EXAMINER	
SUGHRUE MION, PLLC 2100 PENNSYLVANIA AVENUE, N.W. SUITE 800 WASHINGTON, DC 20037			ARORA, AJAY	
			ART UNIT	PAPER NUMBER
			2811	

DATE MAILED: 10/20/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/538,306

Applicant(s)

UEKI ET AL.

Examiner

Ajay K. Arora

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 9/28/06.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 7-25 is/are pending in the application.
- 4a) Of the above claim(s) 7-16 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 17-25 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 09 June 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 6/9/05
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Election/Restrictions***

Applicant's election of 9/28/06, without traverse, of group II, claims 17-25, is noted and the restriction is made final.

### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 21 and 22 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The scope of claims 21 and 22 is unclear because of the term "and/or". It appears from the claim that copper alloy for wiring can have the intermetallic compounds (for claim 21) or oxides (for claim 22) at "the crystal grain boundaries and in the viscinities of the grain boundaries", or "the crystal grain boundaries or in the viscinities of the grain boundaries". It is not clear what applicant is trying to claim.

### ***Claim Rejections - 35 USC § 102***

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(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claim 17, 19, 20, 23, 24 and 25 are rejected under 35 U.S.C. 102(e) as being anticipated by Andricacos (IDS reference EP 0751567 A2), Andricacos.

Regarding claim 17, Andricacos (refer to Figures 3) teaches a copper alloy for wiring (Col. 5, lines 31-36) composed of a polycrystalline copper alloy containing Cu (copper) as a primary element and an additional element (Col. 5, lines 49-54), wherein concentration of the additional element is, at grain boundaries of crystal grains composing the polycrystalline copper alloy and in vicinities of grain boundaries, higher than that of the inside of the crystal grains, a barrier layer (22) is formed to surround the polycrystalline copper alloy, and concentration of the additional element is, at the interface between the polycrystalline copper alloy and the barrier layer and in vicinities of said interface, higher than that of the inside of the crystal grains (Col. 6, lines 41-44).

Regarding claim 19, Andricacos (refer to Figures 3) teaches a copper alloy for wiring (Col. 5, lines 31-36) composed of a polycrystalline copper alloy containing Cu (copper) as a primary element and an additional element (Col. 5, lines 49-54), wherein concentration of the additional element is, at grain boundaries of crystal grains

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composing the polycrystalline copper alloy and in vicinities of grain boundaries, higher than that of the inside of the crystal grains (Col. 6, lines 41-44), and concentration of the additional element in the crystal grains is 0.1 atomic percent or less (Col. 5, lines 49-53).

Regarding claim 20, Andricacos teaches the copper alloy for wiring as set forth in claims 18 or 19, wherein the additional element is at least tin (Col. 5, lines 31-36).

Regarding claim 23, Andricacos (refer to Figure 3) teaches a semiconductor device comprising a substrate (substrate of 26) on which a semiconductor element is formed, and a metal wiring (labelled Cu Alloy) composed of the copper alloy for wiring as set forth in any one of claims 17, 18, 19, 21 or 22.

Regarding claim 24, Andricacos teaches the copper alloy for wiring in any one of claims 18, 19, 21 or 22, wherein concentration of the additional element at the grain boundaries and in the vicinities of grain boundaries is at least 120% of the additional element concentration at the inside of the crystal grains (Col. 3, lines 44-51), and further teaches that the concentration of the additional element at the grain boundaries and in the vicinities of grain boundaries may approach saturation (Col. 6, lines 41-44). Therefore, Andricacos teaches the copper alloy for wiring wherein concentration of the additional element at the grain boundaries and in the vicinities of grain boundaries is on

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the order of 2 to 1000 times the additional element concentration at the inside of the crystal grains.

Regarding claim 25, Andricacos teaches the copper alloy for wiring wherein concentration of the additional element at the grain boundaries and in the vicinities of grain boundaries is at least 120% of the additional element concentration at the inside of the crystal grains (Col. 3, lines 44-51), and further teaches that the concentration of the additional element at the grain boundaries and in the vicinities of grain boundaries may approach saturation (Col. 6, lines 41-44). Therefore, Andricacos teaches the copper alloy for wiring wherein concentration of the additional element at the grain boundaries and in the vicinities of grain boundaries is on the order of 10 to 100 times the additional element concentration at the inside of the crystal grains.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 18 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Andricacos in view of Lee (US 5,552,341), hereinafter Lee.

Regarding claim 18, Andricacos (refer to Figures 3) teaches a copper alloy for wiring (Col. 5, lines 31-36) composed of a polycrystalline copper alloy containing Cu (copper) as a primary element and an additional element (Col. 5, lines 49-54), wherein concentration of the additional element is, at grain boundaries of crystal grains composing the polycrystalline copper alloy and in vicinities of grain boundaries, higher than that of the inside of the crystal grains (Col. 6, lines 41-44), and the oxide of the additional element are formed at said grain boundaries and/or in vicinities of said grain boundaries. Lee (US 5,552,341) discloses alloy compositions for wiring, teaching that it is desirable to form an oxide on the surface of the diffusion barrier layer and in the grain boundary thereof (Col. 5, lines 66-67). It would have been obvious to one of ordinary skills in the art at the time of the invention to modify the device of Andricacos so that the oxide of the additional element are formed at said grain boundaries and/or in vicinities of said grain boundaries. The ordinary artisan would have been motivated to modify Lin for at least the purpose of improving effectiveness of the diffusion barrier (see Lee, Col. 6, lines 1-2).

Regarding claim 22, Andricacos teaches substantially the copper alloy for wiring but does not teach that at the crystal grain boundaries and/or in the vicinities of grain boundaries, "oxides of at least one element selected from a group consisting of Ti, Zr, Hf, Cr, Co, Al, Sn, Ni, Mg, and Ag" are formed". Lee (US 5,552,341) discloses alloy compositions for wiring, teaching that it is desirable to form an oxide on the surface of

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the diffusion barrier layer and in the grain boundary thereof (Col. 5, lines 66-67). It would have been obvious to one of ordinary skills in the art at the time of the invention to modify the device of Andricacos so that the oxide of the additional element are formed at said grain boundaries and/or in vicinities of said grain boundaries. The ordinary artisan would have been motivated to modify Lin for at least the purpose of improving effectiveness of the diffusion barrier (see Lee, Col. 6, lines 1-2).

Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Andricacos in view of Wang (US 6,228,759), hereinafter Wang.

Regarding claim 21, Andricacos teaches the copper alloy for wiring of claim 19 but does not teach that at the crystal grain boundaries and/or in the vicinities of grain boundaries, "intermetallic compounds of Cu and at least one element selected from a group consisting of Ti, Zr, Hf, Cr, Co, Al, Sn, Ni, Mg, and Ag are formed". Wang discloses a copper alloy for wiring, wherein intermetallic compound of Cu and Sn are formed at the crystal grain boundaries and/or in the vicinities of grain boundaries (Col. 6, lines 28-38). It would have been obvious to one of ordinary skills in the art at the time of the invention to modify the device of Andricacos so that at the crystal grain boundaries and/or in the vicinities of grain boundaries, intermetallic compounds of Cu and at least one element selected from a group consisting of Ti, Zr, Hf, Cr, Co, Al, Sn, Ni, Mg, and Ag are formed. The ordinary artisan would have been motivated to modify Lin for at least the purpose of mitigating copper migration (see Wang, Col. 6, lines 34-37).



***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ajay K. Arora whose telephone number is (571) 272-8347. The examiner can normally be reached on Mon through Fri, 8am to 4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on (571) 272-1732. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



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